JPRS-CST-84-005

17 February 1984

China Report

SCIENCE AND TECHNOLOGY

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NATIONAL DEVELOPMENTS

SICHUAN DISCUSSES STRATEGY FOR SCIENTIFIC DEVELOPMENT

HK180201 Chengdu Sichuan Provincial Service in Mandarin 2300 GMT 9 Jan 84

[Text] The 3-day provincial symposium on strategy for scientific and technological development successfully concluded on the afternoon of 7 January. The main aim of the symposium was to study, probe, and exchange views on the strategy for scientific and technological development. The participating comrades closely related their discussion with the lofty strategic goal put forward by the 12th CPC Congress, the new principles of the CPC Central Committee on scientific and technological development, and the spirit of the remarks by Premier Zhao Ziyang on paying attention to and studying the new industrial revolution in the world and on our countermeasures. In connection with the results of their own investigation and study, they put forward many good suggestions, methods, and plans on how to invigorate the economy by relying on scientific and technological advances and so forth.

Vice Governor Kang Zhenhuang made a summary speech at the closing ceremony. He said: This symposium truly reflects the basic principle of the CPC Central Committee for building modernization--that economic construction must depend on science and technology, and science and technology must be geared to the need of economic construction. It has clearly stated the new situation that the province's scientific and technological work has developed from only emphasizing micro-scientific and technological work in the past to integrating both micro- and macro-scientific and technological work. This has led to a gratifying situation in which social sciences combine with natural science, and they jointly promote the four modernizations cause. At the same time, the symposium has also taken notice of present and long-term integration in scientific and technological work.

Comrade Kang Zhenhuang pointed out: Our country is in a historical period of great transformation. To strive for advances in science and technology and to promote economic development are overall strategic issues which our leadership at all levels have to solve during this new period. At present, it is particularly necessary for scientific and technological departments, economic departments, education departments, and enterprise leadership at all

levels to really and effectively lead the work with new thought, new work style, and new method. They must create a healthy general mood of society which attaches great importance to knowledge and scientific and technological advances, so as to really promote the invigoration of the economy as well as to create a new situation in the coordinated development of science and technology and the economy.

Comrade Kang Zhenhuang hoped that the province's scientific and technological circles and the scientific and technological workers would widely take part in the province's major decision-making activities concerning science and technology, the economy, and society, He hoped that they would study ways to bring science and technology into play strategically. He said: At present, they should study and formulate a long-term plan for the development of science and technology.

The symposium was attended by comrades from departments engaged in natural science, social sciences, and scientific and technological economic management, totaling more than 350 people.

CSO: 4008/120

FUJIAN ISSUES CIRCULAR ON SCIENTIFIC WORK

OW151440 Fuzhou Fujian Provincial Service in Mandarin 1130 GMT 13 Jan 84

[Text] The Fujian Provincial CPC Committee and the provincial people's government recently circulated a provincial scientific and technological commission report on strengthening work of the county scientific and technological commissions and issued an accompanying circular.

The circular urged the party and government organizations at all levels to firmly establish the guiding principle that in order to revitalize the economy we must rely on science and technology which, in turn, must be directed to serve economic construction. It called on them to strengthen leadership over scientific and technological work.

The provincial scientific and technological commission's report, a paper which was recently circulated by the provincial CPC committee and the provincial people's government, suggests that the party committees and governments at various levels pay attention to building up the county scientific and technological commissions so that they will be able to play a greater role in implementing our principles on science and technology, exploiting the hilly areas and waterfronts, revitalizing the rural economy and building a socialist new countryside. The report urges party committees and the people's governments at the prefectural level to include the work of the county scientific and technological commissions in their important meeting agendas to improve the leading bodies of those commissions according to the requirements of the four modernizations and set up a number of scientific and technological business organizations to coordinate technological development matters in the prefectural areas. It urged them to pool funds, increase investment in scientific and technological undertakings and improve management of scientific research funds so that more work can be done with limited funds.

CSO: 4008/120

CHINA'S FIRST LINEAR PROTON ACCELERATOR DESCRIBED

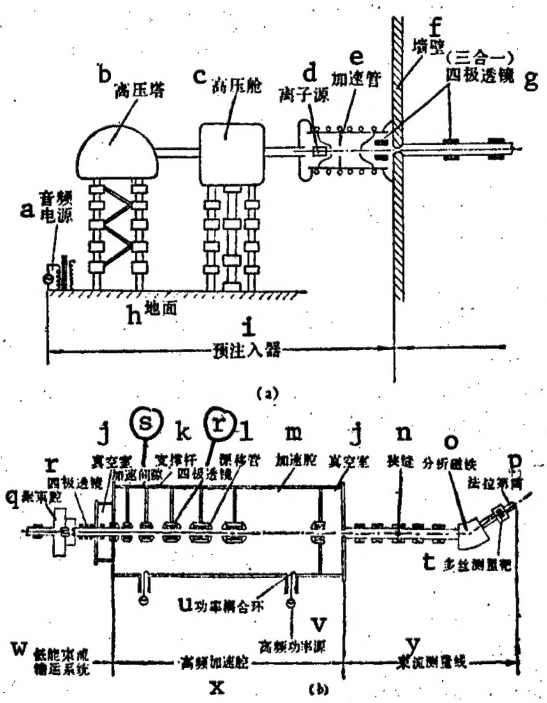
Beijing GAONENG WULI [HIGH ENERGY PHYSICS] in Chinese No 2, 1983 pp 1-2

[Article by Lo Zihua [5012 4793 5478]: "China Builds First Linear Proton Accelerator"]

[Text] Construction of the first linear proton accelerator entirely designed and fabricated by China was recently completed at the Institute of High Energy Physics, CAS. It was first tested before dawn on 17 December 1982 and successfully produced a beam with an energy of 10 MeV [megaelectron-volts], thus meeting design specifications, and a pulse intensity of 14 mA. The accelerator uses the technology of the 1970's and brings together many sciences and technologies, and it involves rather difficult design and fabrication problems. Therefore, many organizations took part in joint design and efforts to solve key problems. Equipment design began in August 1978, the equipment went into production in 1979 and installation of the main facilities began in October 1981; some 4 years elapsed between the beginning of equipment design and the completion of construction. Many difficult technical problems were overcome during the development process. They included: the production and welding technology for large-area composite copper-steel plates; the development of a 5-MW high-power, high-frequency injector; the rolling, welding and precision machining of the accelerator cavity; fabrication of a 750-kV high-stability, high-voltage power source and a high-gradient, large-diameter accelerator tube; precision machining and electron-beam welding of the drift tubes; fabrication of the high-precision, constant-temperature cooling water system and various pieces of superhigh-vacuum equipment; precision manufacture and testing of quadrupole magnets; the computerized automatic control technology for the accelerator; the manufacture of beam-measuring devices; and the like. This was the first time most of this equipment had been manufactured in China. The successful development of the accelerator not only filled China's need for a linear proton accelerator but enabled us to master many difficult processes, technologies and materials. It tempered and trained a technical contingent, which is sure to play a role in the four modernizations.

The basic layout of the linear proton accelerator can be seen in Figures a and b. It includes an injector, a low-energy beam transport system, an accelerator cavity system, a high-frequency power supply system, a magnet

power supply system, a vacuum system, a water cooling system, a beam measurement system, a computer control system, a feed monitoring system and auxiliary systems. These systems make up an indivisible organic whole; if any of them malfunctions, this will directly affect the normal operation of the entire accelerator.



Figures a and b. Layout of linear proton accelerator (Figure b continues Figure a)

Key:

a. Audio frequency power supply
b. High-voltage tower
c. High-voltage cabin
d. Ion source
e. Accelerator tube
f. Wall
g. (3 in 1) quadrupole lenses
h. Ground
i. Injector
j. Vacuum chamber
k. Support rods
l. Drift tubes
m. Accelerator cavity
n. Slit
o. Analyzer magnet
p. Faraday tube
q. Bunching cavity
r. Quadrupole lens
s. Acceleration gaps
t. Polyfilament measurement target
u. Power coupling ring
v. Low-energy beam transport system
w. High-energy acceleration chamber
x. High-frequency power supply
y. Beam measurement line

The preinjector is the head end of the accelerator and imparts an initial acceleration to the protons. It is a 750-kV high-voltage multiplier and consists of a high-voltage generator, an ionizer and a high-gradient accelerator tube. It is the highest-power high-voltage multiplier in this

country. The high-voltage generator has a 5-kHz audio frequency input which is rectified and passed through five voltage-doubler stages to produce a 750-kV high-voltage DC output. This output is fed to the high-voltage cabin and applied to the accelerator tube electrodes, establishing a high-gradient DC field inside the tube. The high-voltage cabin contains the power supply system, cooling system, auxiliary vacuum system, gas feed system and control systems of the ionizer. The ionizer is installed at the entrance to the accelerator tube. When the high-voltage multiplier is in operation, hydrogen gas enters the discharge chamber of the ionizer, and at a specific hydrogen pressure a pulsed-arc discharge produces a plasma by stripping away the electrons from the hydrogen atoms; the nuclei which remain are protons. An attracting voltage of several dozen kilovolts is present at the output end of the ionizer and extracts the protons from it. When these protons pass through the accelerator tube, they come under the action of the very strong field between the electrodes, and their energy and speed are continuously increased. At the output of the accelerator tube each electron has an energy of about 750 keV and a velocity of 12,000 km/sec.

The beam leaving the preinjector passes through the low-energy beam transport system to the accelerator cavity. The low-energy beam system is a beam guide on which are installed, among other things, several quadrupole magnetic lenses and two bunching cavities. The lenses carry out transverse focusing of the beam to prevent it from striking the walls of the cavity and being lost; the bunching cavities are used to change the axial distribution of the particles along the acceleration path by breaking up the continuous beam entering the cavity into groups which meet the particle lock-in requirements of the accelerator.

After the beam enters the accelerator cavity it is continuously accelerated. The accelerator cavity is the body of the accelerator and its main installation. It is a large cylindrical cavity consisting of rolled and welded composite copper-steel slabs whose inner walls have an oxygen-free copper layer about 4 mm thick. The smoothness requirements for the inner surface are extremely high: it must be as bright as a mirror in order to decrease losses resulting from the flow of the high-frequency electric current through the cavity wall. The cavity has an interior diameter of 950 mm and is 7.27 meters long. It is composed of two cavity sections. Along the inside of the cavity are installed a series of suspension rods, from which are suspended 57 cylindrical accelerator poles or "drift tubes" of various lengths made of oxygen-free copper. Within each drift tube is a four-pole magnetic focusing lens. The gap between two adjoining drift tubes is called the acceleration gap. The strong high-frequency power sent out by the 5-MW high-frequency injector of the high-frequency power supply system is transmitted to the interior of the accelerator cavity by two coupling rings in the vicinity of the cavity walls and sets up a very strong high-frequency electric field within the cavity, which is concentrated primarily at the acceleration gaps, while it is near zero inside the drift tubes. The magnitude and direction of the field change very rapidly in accordance with the frequency of the high-frequency power supply, following the direction of motion of the electrons at one moment and running counter to it at the next. The drift tubes must be machined and installed with high precision,

and their lengths must be precisely calculated to assure that when the electric field is in the direction of movement of the proton groups, each of the groups is at an acceleration gap and is accelerated by the field, and that when the field is counter to the direction of movement of the proton groups, all of the groups have entered drift tubes and are not decelerated by it. Thus when a proton is at a gap, it is accelerated, and after passing through 56 acceleration gaps its energy is increased from 750 keV to 10 MeV and its speed from 12,000 km/sec to 45,000 km/sec.

To assure normal operation of the system and to achieve the required beam characteristics, in addition to the systems described above, there are others whose operation must not be forgotten. The vacuum system maintains the vacuum in the beam guide between 10^{-6} and 10^{-7} mm Hg so that the protons are not lost by collision with residual gas molecules. The water cooling system cools all heat-generating components of the accelerator such as the drift tubes, accelerator cavity, quadrupole magnetic lenses, high-frequency injector and the like to assure that they operate normally, and the beam measurement system is the eyes and ears of the system, which measures the beam intensity and shape, the position of the center of the beam, its losses during transit and the like. Based on the measured-beam characteristics, it adjusts the accelerator parameters to keep it in the optimal state. The computer control system is the accelerator's nerve center, which connects all of the accelerator systems into an organic whole and is capable of controlling the startup and shutdown of the accelerator and all of its operating characteristics. When certain of the accelerator characteristics need to be adjusted, the relevant commands are typed in on the control console and can be implemented by the computer and interface system; the dose monitoring system is an essential system which assures worker radiation safety and prevents contamination of the equipment. The high-frequency power supply system provides power to the accelerator, and the magnet power supply system supplies power to the magnets. To summarize, each system has its indispensable responsibility and function.

From the 10-MeV accelerator cavity the beam passes into the beam guide, where it can be injected into the target chamber for nuclear physics experiments or used to produce the short-lived isotope C_{11} for radiation medicine, or the beam can be introduced into another accelerator, which can raise the protons' energy still further and thus achieve even more uses. Therefore, while thoroughly utilizing existing conditions and making use of all of the equipment's potential, without greatly increasing investment the Institute of High Energy Physics is now undertaking to lengthen the accelerator cavity from the current 7.3 meters to 21.8 meters and to use all of the output power of the 5-MW high-frequency unit. This will increase proton energies from the current 10 MeV to 35.5 MeV, which will give the accelerator the highest energy and greatest flux intensity of any proton accelerator currently existing in the country. In keeping with the policy of making science serve the national economy, once the 35.5-MeV linear proton accelerator is completed, two main uses will be developed: (1) production of several short-lived isotopes for medical use which now are largely imported, such as Tl_{201} and Ga_{67}, which are important in the early, accurate diagnosis of certain pathological changes in the cranial and cardiac

blood vessels; (2) development of neutron treatment of cancer, in which the proton beam strikes a beryllium target and produces a neutron beam, which is used to treat tumors, giving much better results than the currently used gamma-ray and X-ray treatment. The neutron beam is highly lethal to tumor cells but does relatively little damage to normal tissue. The Institute of High Energy Physics is currently stepping up construction of this accelerator and applied research related to it so that it will be able to make a contribution to the four modernizations as early as possible.

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CSO: 4008/153

HEAVY-WATER RESEARCH REACTOR REBUILT

Beijing GAONENG WULI [HIGH ENERGY PHYSICS] in Chinese No 2, 1983 pp 4-5

[Article by Lin Chengge [2651 6134 2706]: "A Heavy-Water Research Reactor"]

[Text] On the shaded grounds of the Institute of Atomic Energy in the suburbs of Beijing is a large experimental installation, a heavy-water research reactor. It went into operation in September 1958 as China's first nuclear reactor. In the intervening 20-odd years, much scientific research and experimental work has been carried out on it, and it has been used to train many scientific and technical personnel in the nuclear field. In order to meet the heightened requirements of nuclear research and to modernize the reactor components, which after 20 years of operation had become obsolete and worn, reconstruction of the reactor began in January 1979. The construction work was completed in June 1980, bringing it up to the standards of similar reactors elsewhere in the world and providing yet another modern experimental installation for the country, with a minimal investment and in a rather short time.

I. Uses

What are the uses of a research reactor? What is such a reactor's effect in scientific and technical modernization? Of what kind of work is the Institute of Atomic Energy's heavy-water research reactor capable?

Let us go back to the 1940's. It was fully 10 years after Chadwick's 1932 discovery of the proton that the CP-1, the first fission reactor, was built in the United States under the leadership of Fermi. When the CP-1 went critical, it proved that a thermal neutron system composed of uranium and a moderator material (such as graphite or heavy water) could maintain a self-sustaining chain reaction; this was an epoch-making event. There are now more than 100 research and experimental reactors of various sizes and types worldwide. Following the development of research reactors, nuclear power stations (or power reactors) developed rapidly, and currently 259 nuclear power stations are in operation worldwide, with an installed capacity of 160 million kW.

When a chain reaction takes place in a nuclear reactor, it releases large amounts of energy as well as neutrons and radiation. Power reactors use only the energy produced by nuclear fission, with which they generate electricity or supply heat. Research reactors use only the neutrons and radiation produced by fission and apply it to research and experimentation. Because the two types of reactors have different uses, they also differ considerably in design and construction.

The neutrons and gamma rays emitted during fission have different energies; in other words, they have a continuous energy distribution or "energy spectrum." From an applications standpoint, the neutrons in a reactor are divided into four large energy categories, with some overlap: thermal neutrons between 0.01 and 0.3 eV [electron-volts], epithermal neutrons between 0.3 and 10^4 eV, resonance neutrons between 1 and 100 eV and fast neutrons between 10^3 eV and 10 MeV.

The neutrons and radiation from a reactor can be used for many types of research and experimentation in many sciences such as nuclear physics and neutron physics research, production of radioisotopes, neutron sources and radiation sources, neutron activation analysis, neutron radiography, neutron doping, neutron irradiation and radiochemical research. Many countries have built special research reactors for specific uses such as material-testing reactors used for neutron irradiation testing of materials for use in nuclear power stations and reactors for use in neutron radiography or activation analysis.

The Institute of Nuclear Power's heavy-water research reactor is a multipurpose unit which can be adapted to various types of work. For experimental research or radiation production, experimental devices or specimens can be introduced into the core, or neutrons can be extracted from the reactor for use. In the former case, vertical experimental channels are used, while in the latter case a neutron beam is extracted through horizontal experimental channels.

1. Nuclear Physics Research. The interactions between neutrons and various nuclei constitute an extensive field for research. The neutron reaction cross sections of many materials have already been measured in the heavy-water research reactor. The neutron beam from the horizontal research channel can be used for crystallographic, magnetic and lattic-dynamic neutron-scattering studies. A cold neutron source and a neutron guide are installed on the heavy-water reactor's horizontal research channel. Neutrons which have already been thoroughly moderated in the reactor are subjected to further slowing and diffusion in a low-temperature liquid hydrogen medium which brings their energy close to that of liquid hydrogen, i.e., below 0.01 eV. These cold neutrons are extremely useful in solid-state physics, liquid physics, nuclear physical chemistry and biochemistry.

2. Production of Radioisotopes, Neutron Sources and Radiation Sources. The applications of isotopes are an important aspect of the peaceful use of atomic energy. They are essential in industry, agriculture, defense and scientific research. Radioisotopes can be obtained by two methods: from

irradiation in reactors and from accelerators; the great majority are currently produced by the former method.

The irradiation method is as follows. The target material is placed in an aluminum irradiation container, which is then introduced into the reactor's experimental channel and irradiated for a length of time which is chosen with reference to the radioactive intensity required. After neutron bombardment of the target, the radioisotopes produced are removed from the reactor and separately packaged or chemically treated for use. Three types of nuclear reactions can be used to produce radioisotopes. (1) Neutron fission. Fission of U_{235} (or U_{233} or Pu_{239}) in the reactor produces various fission products, including more than 170 radioisotopes. (2) Thermal neutron capture. An element or compound serving as a target captures a neutron in the reactor and releases gamma radiation, forming a radioisotope. (3) Fast neutron (n, p) and (n, α) reactions. Specific targets are chosen to react with neutrons, liberating protons or alpha particles and producing a different radioactive element. The elements produced in this way are different from the initial target elements, and chemical methods can be used to separate them as radioactive isotopes with no carrier.

The research reactor is already capable of producing more than 100 radioisotopes. Those most commonly used in medicine are P_{23}, Gr_{51}, Co_{60}, I_{128}, I_{131}, Cs_{131}, Au_{198}, molybdenum Tc_{99m} sources, and tin In_{113m} sources. These radioisotopes are furnished as injections or diagnostic drugs. Isotopes for industrial use include various gamma and neutron sources for nondestructive flaw detection, industrial thickness measurement, automatic fire alarms, oil well exploration and the like.

3. Neutron Activation Analysis. In neutron activation analysis, the specimen to be analyzed is activated by neutrons and its radioactivity is measured, after which the amounts of various elements in it are calculated. The method is sensitive, rapid and precise, only a small amount of sample is used, it is nondestructive and several elements can be determined simultaneously. Use of neutrons from a reactor as the activation source gives high sensitivity, because the reactor yields a high flux of thermal neutrons, for which many elements have rather large activation cross sections. Thus reactors are currently used in most activation analyses.

The specimen to be analyzed can be sent rapidly into and out of the reactor by a pneumatic transport system, which is colloquially called the "running rabbit," because it "runs" rapidly into and out of the core like a rabbit, after which a multichannel analyzer connected to a computer performs the determination. The "rabbit" is particularly important for analyzing specimens with a short half-life.

Activation analysis is widely used in the life sciences, space chemistry, geochemistry, environmental science, semiconductor processing research and the like. It is used in the life sciences to study the relationship of microelements to life; it is capable of quantitatively determining trace elements at concentrations down to 1 part per 10 million or 1 part per billion. It is used in semiconductor research to determine trace impurities

in silicon, germanium and gallium arsenide. In space chemistry, it is used to analyze the components of meteor showers in order to study the formation and evolution of meteors. It is used in geochemistry to analyze various rocks and minerals in order to study the factors leading to the formation of deposits and to determine mineral content. In environmental science it is used to determine minute quantities of elements in water, air, earth and biological samples in order to provide data on environmental quality and pollution control.

4. Neutron Radiography. Neutron radiography is a relatively new non-destructive detection technique which is particularly useful in the nuclear industry, the explosives industry and the aerospace industry. Since neutrons have no charge, they can pass through the external-electron cloud and interact directly with the atomic nucleus so that they can be used for both macroscopic and microscopic study of materials and components. When gamma rays or X-rays pass through a material, the attenuation is proportional to its density, so that X-ray or gamma-ray photography of heavy materials is difficult, while this problem does not arise with neutron radiography.

The beam of neutrons from the horizontal channel of the reactor passes through the neutron guide to the body being tested. The neutrons which pass through this body are passed through a converter above a photosensitive emulsion. Because neutrons with different energies affect the body being tested in different ways, thermal neutrons, epithermal neutrons, resonance neutrons or cold neutrons can be used for radiography, depending on which will give the best specific resolution and sharpness under the specific conditions. By passage through various special-neutron filters or cold-neutron devices, thermal neutrons, epithermal neutrons, resonance neutrons or cold neutrons can be obtained from the reactor neutron beam.

5. Neutron Doping. In the past, the semiconductor industry traditionally used the metallurgical doping method to give the desired properties to materials. This method gives poor uniformity, and the acceptance rate is low. In recent years, extensive use has been made abroad of neutron doping, using neutrons from reactors; this method gives good uniformity, good device properties and a high yield. Neutron doping of silicon monocrystals is currently used on a large scale.

Many countries are now studying neutron doping of germanium and gallium arsenide.

Vertical channels of various diameters have been installed in the reconstructed heavy-water reactor and equipped with neutron doping irradiation equipment for this work.

6. Neutron Irradiation. Materials used by the nuclear industry generally must be able to withstand prolonged bombardment by neutrons and gamma rays, i.e., they must have excellent radiation stability. Fuels and other materials for the power reactors of nuclear power stations must first undergo actual neutron irradiation in reactors in order to test their properties.

Its usability for neutron irradiation is one of the heavy-water research reactor's main uses. Fuel for the power reactors of nuclear power stations and design and structural materials can be bombarded with neutrons in the reactor. The largest irradiation space now has a diameter of 120 mm. In addition, a high-pressure, high-temperature cooling circuit for operation at 150 atmospheres and 300°C can be connected to the part to be tested in order to remove the heat produced in the test component by neutron bombardment and to simulate the actual use conditions.

The research reactor has an extremely wide range of uses; those described above are only some of the most common.

II. Reconstruction and Features

It can be seen from the uses of the research reactor that a multipurpose research reactor has various capabilities, as described below.

1. High Neutron Flux. Increasing the neutron flux can increase sensitivity, decrease the time required for experiments and increase the relative strength and yield of isotopes. Some types of research can only be conducted with a high neutron flux.

2. Sufficient experimental irradiation space for the simultaneous performance of several experiments must be provided.

3. Separation of the Neutron Spectrum. Experiments generally require only one range of neutron energies. For example, some use only thermal neutrons, others only resonance neutrons. The experimental channels in different positions within the reactor should have different neutron energy spectra; if special experimental needs still cannot be met, neutron energy filters must be installed.

4. There must be sufficient excess neutrons to allow simultaneous performance of several experiments and to allow materials with very high neutron absorption capabilities to be introduced into the reactor.

Design and construction work aimed at improving the characteristics of the heavy-water research reactor and making it into a multipurpose installation was conducted. This was the first time in China that a reactor that had been in operation for 20 years and was highly radioactive had been reconstructed. Since the core zone and heavy-water piping facilities were highly radioactive, the reconstruction work was much more difficult than under ordinary circumstances. A considerable part of the work had to be performed by remote control. Strict radiation protection measures had to be taken, and the workmen had to wear special work clothes and plastic coats and masks.

The reconstruction took a total of 18 months, including disassembly of the highly radioactive core zone, hoisting out of the old reactor vessel, installation of a new-design reactor core and new reactor vessel,

reconstruction and modernization of the heavy-water piping and equipment and reconstruction or overhaul of all auxiliary systems.

Tests following the reconstruction indicated that the new heavy-water reactor entirely met design specifications.

The reactor has now been operating smoothly for a year, and operating experience indicates that the reconstruction has been entirely successful, the design was correct, its capabilities have been improved and excellent operation has been achieved.

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CSO: 4008/153

BRIEFS

NONDESTRUCTIVE TESTING SYMPOSIUM--The "Laser Holographic Nondestructive Testing Technology Symposium" jointly organized by the New Technology Group of the Chinese Nondestructive Testing Society and Northwestern Polytechnical University was held on 10 August 1982 in Suzhou. Forty-six representatives from 35 related research organizations, colleges and universities and production and user outfits attended the meeting. The delegates believe that laser holographic nondestructive testing technology in our country has already entered the practical application stage from the testing of principles in the early seventies. Significant accomplishments have already been made. It was very timely to hold this technology exchange symposium. From now on, technological exchanges in this area should continue to be strengthened. The practical application of the laser holographic nondestructive testing technology should be taken into serious account. Some items suited for applying laser holographic nondestructive testing should be chosen in order to organize some strength to make the breakthrough. The delegates also wished that the Society and relevant departments would pay more attention to the research on pulse lasers and the production of recording media and other devices. Special plants should be organized to carry out development and production so that this new technique can receive the kind of development it deserves in order to demonstrate its unique effectiveness in the four modernizations. [Text] [Shanghai WUSUN JIANCE [NONDESTRUCTIVE TESTING] in Chinese No 4, 1983 p 11] 12553

AVIATION TESTING MEETING--On 20 September 1982 the Materials Committee of the Society of Aeronautics and Astronautics of China held the "first" aviation nondestructive testing academic meeting in Changde, Hebei. Seventy-five delegates from 40 outfits under the Aviation Industry Ministry, Civil Aviation Corporation of China, Air Force Engineering Department and Astronautical Industry Department attended the meeting. The meeting was organized by the Beijing Aeronautical Material Research Institute. Sixty-three papers were presented at the meeting. Those attending the meeting were mostly middle-aged intellects who have been working for many years on nondestructive testing in production, research and teaching. They worked hard for the continuing development and improvement of aviation nondestructive testing technology. The delegates conducted enthusiastic discussions of the contents of the reports. Furthermore, special-topic technological discussion sessions were held. The delegates were very interested in the problems discussed. It was widely

reflected to be highly beneficial. In the meeting, suggestions were made to the relevant authorities regarding the development of aviation nondestructive testing technology. During the conference, the first meeting of the Aviation Nondestructive Testing Special Group was also held to discuss the organization of academic activities for the next year and the key points of the future work of the special group. [Text] [Shanghai WUSUN JIANCE [NONDESTRUCTIVE TESTING] in Chinese No 4, 1983 p 7] 12553

IRON AND STEEL INDUSTRY MEETING--As entrusted by the Party Organization of the Ministry of Metallurgical Industry, the Metallurgy Society of China held the discussion meeting of technical and equipment experts in the iron and steel industry in Beijing on 19-25 June. One hundred seventy-eight experts and scholars from the iron and steel enterprises, research institutes, institutions of higher learning and management organizations attended this meeting. In the meeting, the preliminary technical and equipment policy of the iron and steel industry and the long-term planning outline were reviewed. After taking the scale of the meeting into account, the discussions on eight special fields in pellet sintering, iron smelting, steel smelting, continuous steel casting, coking chemistry, refractory materials, metallurgical energy resources and metallurgical automation were arranged. The other special fields will hold individual discussion later. The documents presented at the meeting for consideration were: "Technical and Equipment Policy of the Iron and Steel Industry," "Outlines of the Long-Term Development of Iron and Steel Industry Technology," "Outlines of Medium- and Long-Term Planning of Technological Development and Technical Reform in the Iron and Steel Industry" and the special-field planning outlines of various related special fields. In addition, the references of various related special fields were also presented at this meeting. In the meeting, Zhou Chuandian [0719 0278 0368], deputy minister of the Metallurgical Industry Ministry, gave a report on the importance of drawing up a technical policy on the future development of the metallurgical industry. Furthermore, he gave some explanation to the technical policy and planning outline that had been drawn up. Vice Chairman Wang Xun [3769 8113] of the Metallurgical Society of China spoke at the opening of the meeting. During the meeting, the delegates seriously studied the speeches given by Comrades Song Ping [1345 1627], Lu Dong [0712 2639] and Zhao Dongwan [6392 2639 1354] concerning long-term planning. The experts and scholars attending the meeting seriously discussed the documents presented to the meeting for consideration. Each special field presented separate drafts of modifications as references for the relevant authority in the decisionmaking process. During the discussion process, the experts and scholars expressed their own opinions without reservation. They not only fully carried forward academic democracy but also functioned well as consultants to the Society. In the meeting, half of the delegates were middle-aged key members in science and technology. This was unprecedented in previous meetings of the experts. These middle-aged scientific and technological key personnel on the front lines of production, research, design and education functioned very well in the meeting. In the meeting, the experts and scholars also presented some constructive opinions regarding the drawing up of technical policies, technical development plans and technical improvement plans. These opinions will be beneficial to the

future modification and discussion of technical and equipment policies as well as to the research and formulation of plans. [Text] [Beijing GANGTE [IRON AND STEEL] in Chinese No 9, 1983 p 76] 12553

SHANXI METAL SOCIETY MEETING--Shanxi Society of Metallurgy held its annual academic meeting in Tai Yuan on 9-12 May 1983. The entire Board of Directors of the Shanxi Society of Metallurgy, the responsible persons of various sections and special-field academic committees, the representatives from the outstanding groups in terms of academic activities and outstanding members as rated by the Society in 1982, authors of papers and delegates from relevant units attended the meeting. In this annual academic meeting, 83 academic papers and reports were presented in total. The contents involved over a dozen special fields in metallurgical geology, mining, iron smelting, steel smelting, ferrous alloys, refractory materials, metallurgy and metallurgical physics, physiochemical testing, nonferrous metal metallurgy, technical economics, metallurgical energy resources, metallurgical equipment, etc. In the meeting, the famous model worker in Shanxi Province, awardee of a first-class National Technical Invention Award and senior engineer at the Tia Yuan Heavy Machinery Plant, Chen Zhisheng [7115 1807 5168], was specially invited to give a report on his major research accomplishment in the curve of holes penetrating a steel pipe. Prof Ni Xuezi [0242 1331 2737] of the Beijing Iron and Steel Institute was specially invited to report on the study of theories on energy resources. A metallurgical engineer from the Tia Yuan Iron and Steel Company was invited to give a report on the investigation of quality management in Japan. Ji Minxiu [0370 2404 4423], chairman of the Shanxi Society of Metallurgy, gave a work report. [Text] [Beijing GANGTE [IRON AND STEEL] in Chinese No 9, 1983 p 76] 12553

CYBERNETICS MEETING--A "Discussion Meeting on the Application Results of Cybernetics," jointly sponsored by the Cybernetics Committee and Applications Committee of the Automation Society of China, was held in Daqing between 8 and 14 June 1983. The meeting was presided over by Comrade Shu Songgui [3990 2646 2710], deputy director of the Society and vice chairman of the Cybernetics Committee, and Chen Zhenyu [7115 2182 1342], chairman of the Applications Committee. More than 100 delegates from over 50 outfits in the nation attended the meeting. The meeting received over 30 academic papers and technical reports. Academic exchanges were carried out in three groups. The first group dealt with the applications of cybernetics to defense industries. The second group dealt with the practical applications of forecasting and projection to the exploration of oil field, weather forecasting, epidemic information and blast furnace smelting. The third group dealt with the applications to production in the iron and steel, construction materials and textile industries. The delegates enthusiastically and thoroughly discussed the reports by groups. Most of the papers and technical reports presented in the meeting had a strong background in practical application. A number of the research accomplishments have obtained significant economical and social benefits. Over a dozen research results, such as "A Method To Study the Optimal Planning of an Oil Field Using Optimization Technique" and "Application of a Self-Adapting Forecasting Method in Oil Fields" by the Daqing Petroleum Science

Research and Design Institute, "Application of a Multi-Step Forecasting Method in Long-Range Weather Forecasting" by the Meteorological Station in Heilongjiang Province and "A Multiple-Variable, Closed-Loop Combustion Control System in a Glass Furnace" by the Radio Department of Lanzhou University were regarded highly by the delegates. All the delegates believed that this meeting was successful. [Text] [Beijing ZIDONGHUA XUEBAO [ACTA AUTOMATICA SINICA] in Chinese No 4, 1983 p 320] 12553

ADVANCED OPTICAL INDICATOR--Changchun, 26 Jan (XINHUA)--An advanced optical indicator used to modernize production control and management has been contributed by scientists of the Changchun Institute of Physics in northeast China. A panel of 30 specialists recently gathered here to appraise the device, called a multi-color electroluminescence dynamic analogue and digital indicator. The indicator will be put to use in the control center of a grain warehouse in Dalian, scientists said. Institute scientists say that it can also be widely used in national defense, economic construction and space science. [Text] [OW261354 Beijing XINHUA in English 0705 GMT 26 Jan 84]

FIRST MICROCOMPUTER-CONTROLLED ROBOT--Beijing, 22 Jan (XINHUA)--China's first robot has made an exhibition show at the Guangzhou Machine Tools Research Institute recently, the PEOPLE'S DAILY reports today, quoting the QUANGZHOU DAILY. The microcomputer-controlled robot can lift an object as heavy as 35 kilograms. Its arm's reach is one meter, with a horizontal radial range of 200 degrees and a 55-degree angle of pitch. Its wrist revolves and swings. It can deliver workpieces, reposition them and do loading and unloading. The robot can also be used to operate mechanical equipment for working, cutting, painting and welding processes. [Text] [OW220438 Beijing XINHUA in English 0242 GMT 22 Jan 84]

CSO: 4010/41

SHANGHAI EYE BANK PROVIDES CORNEAS FOR KERATOPLASTY

Shanghai JIEFANG RIBAO in Chinese 5 Sep 83 p 1

[Article by Cao Yuhe [2580 3768 0735]: "Shanghai Eye Bank Plays a Special Role: Eye Patients Regain Their Sight; In the Last 2 Years, the Bank Has Provided Relevant Units With 120-some Corneas; Corneal Preservation and Surgical Technique Have Attained International Standards"]

[Text] The Ophthalmology Institute of the Shanghai First Affiliated Hospital has a unique storehouse--a corneal eye bank. Whenever a hospital in the municipality needs to perform keratoplasty, it can obtain corneas from the bank. As of last August, this special bank had already provided relevant units with 123 corneas.

Established in 1981, this eye bank has enabled patients to escape blindness or regain their sight. The bank's corneal preservation and surgical techniques have attained international standards and lead the nation.

This reporter paid a visit to the eye bank the other day. When I entered the keratoplasty office, I saw rows of glass dessicators containing many small glass vials, each holding one transparent cornea and bearing a number and a record of the date of preservation, thickness and size of the cornea it contained. Most corneas can be preserved for 3 years using dehydration. On two occasions, Zhongxin Hospital in Yangpu District requested corneas from the bank to perform emergency operations on patients suffering from acute corneal performation caused by viral keratitis. Both operations were successful, and doctors at that hospital said that it would have been impossible to save the patients' sight had there been no eye bank in Shanghai.

Corneas preserved through dehydration can only be used on patients suffering from corneal surface injuries and can do nothing to treat those with damage to the deeper layers. Under the guidance of Prof Guo Bingkuan [6753 4426 1404], director of the institute and a famous ophthalmologist, and Assistant Director Chen Daoyu [7115 6670 3842], technicians of the keratoplasty office advanced into the more difficult realm of viable-cornea preservation research. Subsequently, the institute collaborated with the Shanghai Central Blood Bank for 2 years and successfully developed a tissue nutritive fluid that can preserve fresh corneas for 4 or 5 days, up to 7 at the

longest. The institute has already used such corneas to perform penetrative keratoplasty on 30 patients, registering a success rate of 70 percent.

During my visit, I saw a Mr Yu, a middle-aged man who had come to the hospital for a follow-up examination. Both of this patient's eyes appeared clear, and it was hard to discern which had undergone the corneal graft. While conducting his examination, the doctor explained that the left eye had been perforated by viral keratitis, so the patient came all the way from Jiangxi to Shanghai for treatment. Qiu Xiaozhi [6726 1321 5347], the attending physician of the keratoplasty office, performed a meticulous, 2-hour transplant operation, and owing to the severity of the case, the graft required a 9.5-mm operative diameter, which is rare even at the international level (6 mm being normal). When the examination was completed, the doctor informed the patient that his eyesight had been corrected to 0.6, at which the latter, satisfied, responded: "That's right, my vision is recovering very nicely. Now I can go back to work."

Guo Bingkuan, who performed the first corneal graft in China 40 years ago, has devoted his life to the study of this technique. He told me that since its opening, the eye bank has performed its proper role, won tremendous support from all sectors and even received many letters offering corneal donations. Yet the supply of corneas, said Guo, is still insufficient to meet the patients' demand. Thus he appealed to people of all walks of life generously to donate their remains to the hospital and thereby enable some of their tissue cells to continue to survive and function in this world.

12431
CSO: 4008/30

CLINICAL AND EPIDEMIOLOGICAL ANALYSIS OF BOTULISM IN CHINA

Beijing ZHONGHUA YUFANG YIXUE ZAZHI [CHINESE JOURNAL OF PREVENTIVE MEDICINE] in Chinese No 5, Sep 83 pp 310-311

[Article by Hou Zhengzong [0186 2973 1350] of Hebei Province Sanitation and Antiepidemic Station: "Clinical and Epidemiological Analysis of Botulism in China"]

[Text] Worldwide concern over botulism was aroused in 1896 by Dr Ermengen with the discovery of clostridium botulinum, which caused botulism. In 1958, Wu Chaoren and other researchers proved that the "chabucher disease" was a kind of botulism.[1] Since then, there has been reports of botulism occurrences in 15 provinces (regions). To find out the pattern of botulism occurrences in China and to provide a basis for the prevention and cure of botulism, I have made some preliminary analyses based on part of the material collected in China.

1. General Situation of Occurrence

The first region in which botulism is reported in Xinjiang. Up to the present, the number of botulism incidents reported in Xinjiang makes it number one in the nation in occurrences.[2] Other provinces (regions) where the number of botulism occurrences can be ranked, in descending order, are: Qinghai,[3] Tibet Autonomous Region,[4] Hebei,[5] Shandong,[6] etc. As shown in Table 1, the major botulism occurrence area in China is in the northwest regions and on the Qinghai-Xizang plateau. A small number of botulism incidents do occur in the inland regions. In the coastal regions only three provinces--Hebei, Shandong and Guangdong--have reported such incidents. No report has been shown on the other provinces. Botulism incidents in the three provinces, however, mainly occur in the inland plain or mountain areas. The characteristics of the occurrences suggest to us that to prevent and cure botulsim, we need to do a good job in the treatment and prevention of botulism in the regions where botulism has already occurred. In addition, we should also investigate the background of the coastal regions in order to understand the basic reasons for the disease incidents.

Table 1. General Survey of Botulism Occurrence

Province (Region)	Number of Occurrences--%		Number of Patients	Type of Botulism
Xinjiang	593	84.96	1,801	A, B
Qinghai	36	5.16	152	E, A, B
Xizang	27	3.87	199	E
Hebei	11	1.58	83	B, A,
Shandong	9*	1.29	142	B, A, E
Gansu	5	0.72	30	B, A
Shaanxi	5	0.72	24	B, A
Henan	3	0.43	25	B
Ningxia	2	0.29	46	B
Guangdong	2	0.29		
Sichuan	1	0.14	78	
Hubei	1	0.14	15	B
Jilin	1	0.14	13	E
Heilongjiang	1	0.14	4	E
Neimenggu	1	0.14		
Total	698	100.00	2,612	A, B, E

Note: Incomplete 1958-1980 statistics are used for this table.
*The two incidents in 1981 are included.

2. Types of Botulism

Three types of botulism toxins have been discovered abroad: A, B, and E. Our discoveries in China are basically the same. However, we also observed some regional characteristics: Type A botulism occurred largely in Xinjiang;[2] Type E occurred in the Qinghai[3,8] and Tibet regions; and one case each of Type E occurred in the inland areas of Heilongjiang, Jilin and Shandong. Our Type E botulism distribution characteristic is not completely congruent with the "ocean theory" of western nations.

3. Poisonous Food

Essentially, two conditions of food poisoning can be observed from the data on the 318 incidents of food poisoning reported.

First, in Tibet and Qinghai where minority nationalities live, particularly in the Tibetan pastoral area, since the major foodstuff is meat and dairy products, what causes food poisoning is mainly beef and lamb meat. Herdsmen slaughter large numbers of cows and lambs in late autumn and store the meat for use during the winter months. Slaughtering is usually done in the pasture. According to an investigation, clostridium botulinum exists in the natural environment of the Qinghai-Xizang pastoral area. The food contamination rate by clostridium botulinum is 8.2 percent in Qinghai and 15.6 percent in Xizang. It is thus easy to contaminate meat during the process of slaughtering. Preservation of meat is done by storing large chunks of meat

in leather bags which are then buried in the manuare piles outside tents or in wooden boxes. Some meat is hung in the tent. The meat would last until the next March or April. As time passes, the surface of the meat dries up to an airtight film. Inside the film, the oxygenless environment is perfect for clostridium botulinum. Because the Tibetan herdsmen are accustomed to eat rare or semi-rare meat, the chances for food poisoning are increased.

Second, in other provinces (regions), including Xinjiang, botulism is mainly caused by fermented food made from soya beans. Botulism is caused by the clostridium botulinum that exists in the natural environment or that is generated during food fermentation, which is done in a closed environment under a stable temperature. The oxygenless environment is suitable for clostridium botulinum to thrive and to emit poison. Also, the fermented food is ordinarily not heated before serving. Judging from the above facts, the key to botulism prevention is for Tibetan pastoral area people to change their meat preservation methods and to refrain from eating rare meat and for the people in other provinces (regions) to improve the household sideline production technology for making fermented food from soya beans. The thrust of the reform is to avoid contamination by clostridium botulinum, thus basically solving the problem of botulism.

Table 2. Varieties of Food Causing Botulism in 318 Incidents

Poisoning food		Region of Occurrence						Total	
Category	Variety	Xinjiang	Qinghai	Xizang	Hebei	Shandong	Other	Incidents	%
Fermented bean curd		42	1		10	3	9	65	20.4
Soya Bean milk		104	1		1	3		109	34.3
Fermented soya beans		31						31	9.8
Red bean curd		1						1	0.3
Sauce made of fermented flour		15				1		16	5.0
Wheat bran sauce		4						4	1.2
Soybean soup		3						3	0.9
Subtotal		200	2	0	11	7	9	229	72.0
Beef		2	21	15				38	11.9
Lamb		5	13	4				22	6.9
Pork		2		1				3	0.9
Horse meat		1						1	0.3
Cured meat		5						5	1.6
Marmot meat								2	0.6
Fish		2						2	0.6
Canned meat						2		2	0.6
Zongzi*							2	2	0.6
Strong-smelling preserved egg		2						2	0.6
Hog viscera							1	1	0.3
Subtotal		19	34	22	0	2	3	80	25.1
Undetermined food		4		5				9	2.9
Total		223	36	27	11	9	12	318	100.0

*a pyramid-shaped dumpling made of glutinous rice wrapped in bamboo or red leaves (meat-filled variety)

4. Form of Occurrence

Botulism breaks out suddenly in two forms: collective incidents and clan-based incidents. Collective incidents are caused by a large number of people eating the same contaminated food in a mass dining hall are relatively rare. Only four incidents have been reported in Qingdao, Sichuan, Ningxia and Hubei. Food poisoning happens more frequently in China among families, clan members and close neighbors or friends eating the same contaminated food (homemade fermented soya bean food) given as presents.

5. Clinical Data Analysis

A. Incubation Period: Based on the statistics drawn from the 386 incidents, the shortest period is 2 hours while the longest period is 60 days. Eighty percent of the patients had incubation periods of from 2 to ten days. The majority of cases in the report indicated that, generally, the shorter the incubation period, the more serious the condition is, which is also combined with a higher mortality rate. However, there were incidents in which the incubation period was short, yet no death was reported.[7]

B. Incidence Rates and Mortality Rates: According to the statistics based on 45 incidents, of the 558 people eating the same food, 429 became ill. The incidence rate was 76.9 percent. Other statistics based on 437 incidents showed that a total of 1,713 became ill. An average incident involved 3.9 people. The number of people who died of the illness was 209, and the average mortality rate was 12.2 percent, which is lower than that of both Japan and the United States.[10] A regional mortality analysis demonstrated that of the five incidents of Type E botulism occurring in Qinghai, 26 became sick, and 22 died. The mortality rate was as high as 84.6 percent. In Xinjiang, the mortality rate was 12.1 percent,[2] in Shandong 7.8 percent and in Hebei 1.2 percent. There are reports of Type B botulism from Ningxia, Shaanxi, Shandong, Hebei,[6,7,11] etc. Judging from the data gathered within the nation, Type B botulism has the lowest mortality rate, followed by Type A and Type E in increasing order. In addition to the differences in toxin types, mortality rates also are affected by the type of food and the amount of food intake. The food causing Type B botulism in the four provinces (regions) was largely household food made from fermented soya beans. These foods were served as small side dishes from which people took a small amount at each meal. As for the five incidents of Type E botulism, they were beef or lamb related. The amounts of intake are generally larger than those of the side dishes from fermented soya bean sources; consequently, larger doses of toxin found their way into the victims. It is also possible that poor transportation in the inland area hindered timely treatment, thus causing higher mortality rates.

C. Symptoms and body signs: According to the statistics on the symptoms and body signs of the 1,124 patients observed, non-idiosyncratic signs include: dizziness (690 cases, 61.4 percent), headache (233 cases, 20.7 percent) nausea (193 cases, 17.2 percent), vomiting (113 cases, 10.1 percent), stomach-ache (67 cases, 6.0 percent), diarrhea (74 cases, 6.6 percent) and abdominal distention (9.2 cases, 8.2 percent); idiosyncratic signs include:

blurred vision (760 cases, 67.6 percent), pupil expansion (160 cases, 14.2 percent), slow reflex to light (61 cases, 5.4 percent), double vision (405 cases, 35.0 percent), blepharoptosis (664 cases, 57.3 percent), hoarseness of voice (71 cases, 6.3 percent), language obstruction (284 cases, 25.3 percent), swallowing difficulty (647 cases, 57.6 percent), thirst (198 cases, 17.6 percent), constipation (125 cases, 11.1 percent), breathing difficulty (118 cases, 10.5 percent) and loss of voice (193 cases, 17.2 percent). In addition to the above symptoms, some patients could not close their mouths with extended tongues. Some had difficulty lifting their heads. Some felt limp or could not control drivel. But all patients were conscious and had normal body temperatures.

The majority of the reports holds that timely use of an antitoxin can lower the mortality rate. General supporting therapy should be well administered.

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12453
CSO: 4008/79

NANJING UNIVERSITY DEVELOPS SWINE THYMOSIN

Shanghai WEN HUI BAO in Chinese 12 Aug 83 p 2

[Article by Fang Yanming [2455 1693 2494]: "China Successfully Develops Swine Thymosin: There Is a New Drug To Regulate the Immunological System"]

[Text] Swine thymosin, a new drug that possesses great medical value, has been successfully developed by Nanjing University and the Taizhou Biochemical Pharmaceutical Co., employed clinically for the first time in the world and won first-prize awards from the Ministries of Public Health and Commerce.

Thymosin is a hormone extracted from animal thymic tissue; swine thymosin regulates the immunological system. Research in this field has developed only within the last decade, with bovine thymosin first being applied clinically by the Americans in 1974.

Nanjing University's Department of Biology and the Taizhou Biochemical Pharmaceutical Co. began developing thymosin in 1977. Comrades of the Thymic Hormone Development Group of the Department of Biology consulted much foreign literature on the subject and decided, based on national conditions, to focus their research on swine thymosin. After several years of effort, this distinctively Chinese preparation was experimentally produced. Compared with bovine thymosin produced in the United States, the drug is similarly competent and nontoxic and has no side effects. In the United States bovine thymosin is employed principally to treat primary cellular immunodeficiency and some tumors, while in China swine thymosin is used primarily for autoimmune disease. The results of 625 clinical test cases, however, indicate that swine thymosin can also be used to treat, with distinct curative effect, refractory diseases such as hepatitis gravis, rheumatoid arthritis, systemic lupus erythematosus and recurrent apthae.

During the course of this research, the thymic hormone development group published six reports in influential academic journals such as BIOCHEMISTRY AND BIOPHYSICS [SHENGHUA YU SHENGWU WULI XUEBAO], which reports attracted much close attention from domestic and foreign experts in the field. Currently the group is continuing its investigation into the way in which thymic hormones promote T-cell development. The Jiangsu Provincial Public Health Department has formally approved production of swine thymosin by the Taizhou Biochemical Pharmaceutical Co.

12431
CSO: 4008/30

BRIEFS

GASTRIC HYBRIDOMA CELLS--Dong Zhiwei [5516 1807 0251] and other young and middle-aged researchers of the Beijing Municipal Cancer Prevention Institute have successfully cultured the first gastric hybridoma cells in China, an important development in the key national scientific task of gastric-cancer prevention research. Produced through tumor hybridization, this cell secretes immunoglobulin, a monoclonal antibody. The most outstanding characteristics of the cell are that it can be cultured externally to the human body and that the immunoglobulins it produces are specific and can distinguish cancer cells and carry "killer agents" such as cytotoxins, which inhibit the growth of cancer cells. Scientists are pursuing their research in order ultimately to apply the drug to early diagnosis and treatment of gastric cancer. According to experts, this research was rigorous in design, advanced in method and equal to world standards. [Text] [Beijing RENMIN RIBAO in Chinese 2 Oct 83 p 1] 12431

CSO: 4008/30

END